

BMP #16 - Slope Roughening

Targeted Pollutants	
<input checked="" type="radio"/>	Sediment
<input type="radio"/>	Phosphorus
<input type="radio"/>	Trace metals
<input type="radio"/>	Bacteria
<input type="radio"/>	Petroleum hydrocarbons

Physical Limits	
Drainage area	<u>1 ac</u>
Max slope	<u>20%</u>
Min bedrock depth	<u>3 ft</u>
Min water table	<u>5 ft</u>
SCS soil type	<u>BCD</u>
Freeze/Thaw	<u>good</u>
Drainage/Flood control	<u>no</u>

DESCRIPTION

This BMP entails establishing a rough soil surface by creating horizontal grooves, furrows, depressions, or steps running parallel to the slope contour over the entire face of a slope. This reduces the speed of runoff, increases infiltration, and traps sediment. It also helps establish vegetative cover by reducing runoff velocity and providing stable, level areas where seedlings can take hold and grow. This measure may be used prior to seeding/planting and should be applied using appropriate machinery.

Alternately, in some cases, leaving the slope in a roughened condition will control erosion and provide suitable rooting areas for plant seedlings better than a finely-graded slope. Other measures, such as flow diversion must be used to keep erosion from occurring while vegetation is being established.

APPLICATIONS

Slope and surface roughening provide simple, inexpensive, and immediate short-term erosion control for bare soil where vegetative cover is not yet established. The practice is appropriate for all slopes, although different methods are used depending on the steepness of the slope, the type of slope (cut or fill), soil and rock characteristics, future mowing and maintenance requirements, and type of equipment available. All slopes steeper than 3:1 and greater than 5 ft (1.5 meters) vertical height require roughening and may also require terracing,

grooving, or furrowing prior to seeding.

LIMITATIONS

This BMP is limited to slopes in medium to highly cohesive soils or in soft rock which can be excavated without ripping. Slope angle must be gentle enough to permit access to heavy equipment. The method is not applicable for use in moraines and other depositional soils. In addition, serration is of limited effectiveness in anything more than a gentle rain, and it is only a temporary measure. If the roughening is washed away in a heavy storm, the surface will have to be reroughened and reseeded.

This BMP is not a stand-alone measure, it must be implemented in conjunction with other BMPs.

DESIGN PARAMETERS

Slope roughening can be used with seeding, planting, and temporary mulching to stabilize an area. For steeper slopes and slopes that will be left roughened for longer period of time, try a combination of surface roughening and vegetative stabilization. Surface roughening should be applied immediately after grading activities have ceased (temporarily or permanently) in an area.

Different methods can be used to roughen the slope surface. They include stair-step grading, grooving (using disks, spring harrows, or teeth on a front-end loader), and tracking (driving a crawler tractor up and

down a slope, leaving the cleat imprints perpendicular to the slope). The selection of an appropriate method depends on the grade of the slope, mowing requirements after vegetative cover is established, whether the slope was formed by cutting or filling, and type of equipment available.

Slopes steeper than 2:1: Any slope steeper than 2:1 should be terraced or stair-step graded, with benches wide enough to retain sediment eroded from the slope above. See BMP #17 (Gradient Terracing).

Slopes between 3:1 and 2:1: Cut slopes with a gradient steeper than 3:1 but less than 2:1 should be stair-step graded or groove cut. Stair-step grading works well with soils containing large amounts of small rock. Each step catches material discarded from above and provides a level site where vegetation can grow. Stairs should be wide enough to work with standard earth-moving equipment. Grooving can be done by any implement that can be safely operated on the slope, including those described above. Grooves should not be less than 3.1 in (80 mm) deep or more than 16 in (400 mm) apart.

Fill slopes with a gradient steeper than 3:1 but less than 2:1 should be compacted every 12 in (300 mm) of depth. The face of the slope should consist of loose, uncompacted fill 4 to 6 in (100 to 150 mm) deep that can be left rough or can be grooved as described above, if necessary.

It is important to avoid excessive compacting of the soil surface, especially when tracking, because soil compaction inhibits vegetation growth and causes higher runoff speed. Therefore, it is best to limit roughening with tracked machinery to sandy soils that do not compact easily and to avoid tracking on clay soils.

Slopes flatter than 3:1: Any cut or filled slope that will be mowed should have a gradient less than 3:1. Such a slope can be roughened with shallow grooves parallel to the slope contour by using normal tilling. Grooves should be close together (less than 10 in (250 mm)) and not less than 1 in (25 mm) deep.

CONSTRUCTION GUIDELINES

Timing of work: To slow erosion, slope or surface roughening should be done as soon as possible after the vegetation has been removed from the slope. The roughened areas should be seeded as quickly as possible, preferably within seven days after serration/roughening if weather conditions or water availability permits. In material that ravels or sloughs readily, delay the revegetation effort until at least 30 days after slope serration.

On slopes composed of material that weathers rapidly, slope roughening should be completed early in the summer. This will allow material to slough off the step face prior to fall seeding or planting so it does not smother the seeds or seedlings.

Equipment: Various types of heavy equipment of various kinds can be successfully used for slope roughening:

- A front-end loader equipped with disks, harrows, or teeth can make grooves across the slope.
- Driving a crawler tractor up and down the slope will make cleat imprints perpendicular to the slope.
- A dozer, equipped with a special blade containing a series of square grooves and positioned at the same angle as the cut, can serrate the slope along the contours.

Methods:

- Fill slopes constructed with highly erodible soils or soils containing high-clay contents shall be minimally compacted prior to establishing a roughened surface. However, excessive compaction of the surface soil is undesirable because of reduction in infiltration and suppression of vegetation rooting.
- Make the grooves or depressions approximately horizontal (or parallel the roadway grade if its profile grade is less than 2 percent).
- Excavate each series of grooves in the opposite direction from the preceding series to minimize buildup of loose material at the ends of the steps or cuts.
- Loose material collected at the ends of steps should be removed and the ends blended into the natural ground surface.
- If encountering rock that is too hard to rip, try to blend the grooves into the rock.
- Remove materials which fall into the ditchline or roadway and any rock fragments larger than one-third the shelf width.
- Construct a slope bench at the bottom of the slope face.

MAINTENANCE

Inspect the slopes periodically for damage from surface runoff and seepage and inspect after each runoff-producing storm. Damage caused by construction-related activities should be repaired as soon as possible. If rills appear (small watercourses that have steep sides and are usually less than 100 mm deep), they should be immediately filled, and the slope should be promptly regraded and adequately protected.

UNDISTURBED AREA

HEAVY EQUIPMENT CAN BE
USED TO MECHANICALLY
SCARIFY SLOPES



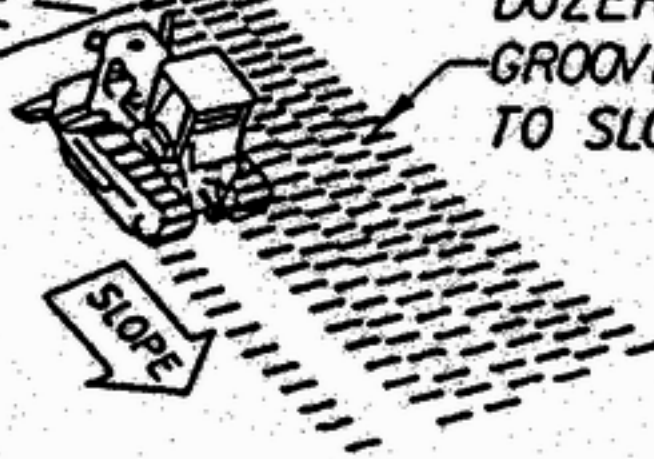
TREAD GROOVES OF
TRACK PERPENDICULAR
TO SLOPE DIRECTION

UNDISTURBED
VEGETATION



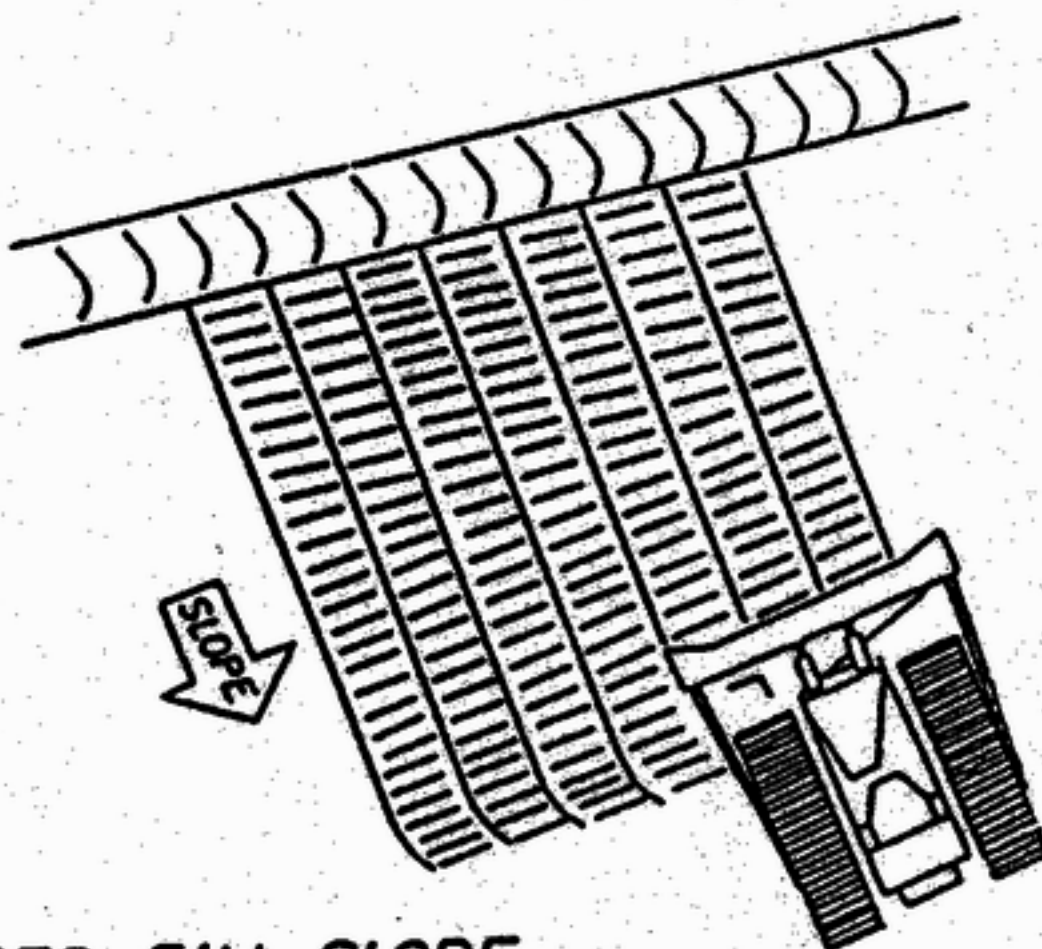
DIVERSION

DOZER TREADS CREATE
GROOVES PERPENDICULAR
TO SLOPE DIRECTION



UNVEGETATED SLOPES SHOULD BE TEMPORARILY
SCARIFIED TO MINIMIZE RUNOFF VELOCITIES

SURFACE ROUGHENING



SCARIFIED FILL SLOPE